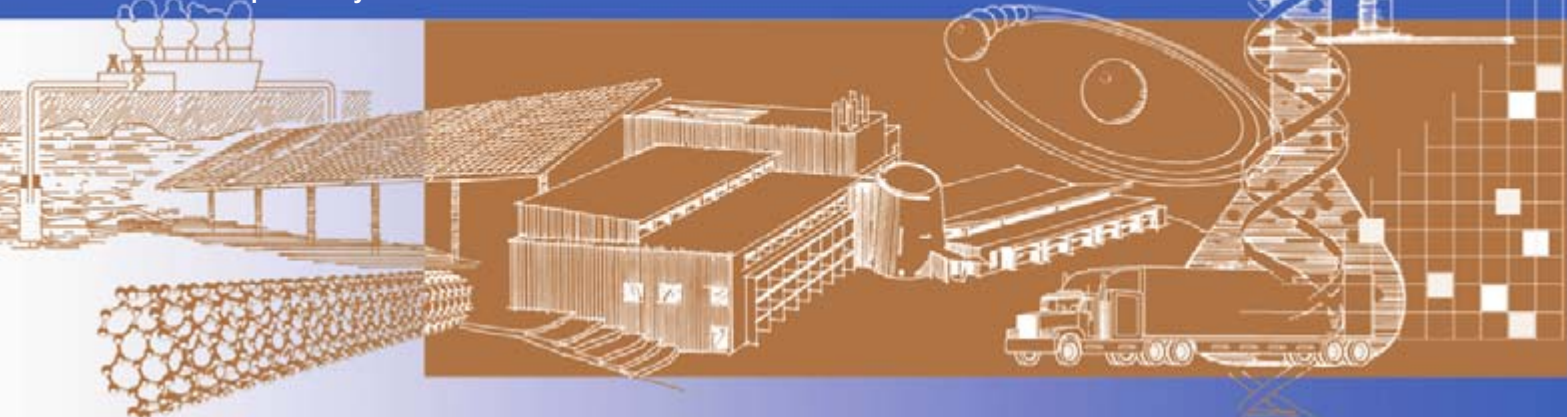


RTD Biodiesel (B20) Transit Bus Evaluation: Interim Review Summary

K. Proc, R. Barnitt, and R.L. McCormick

Technical Report
NREL/TP-540-38364
August 2005

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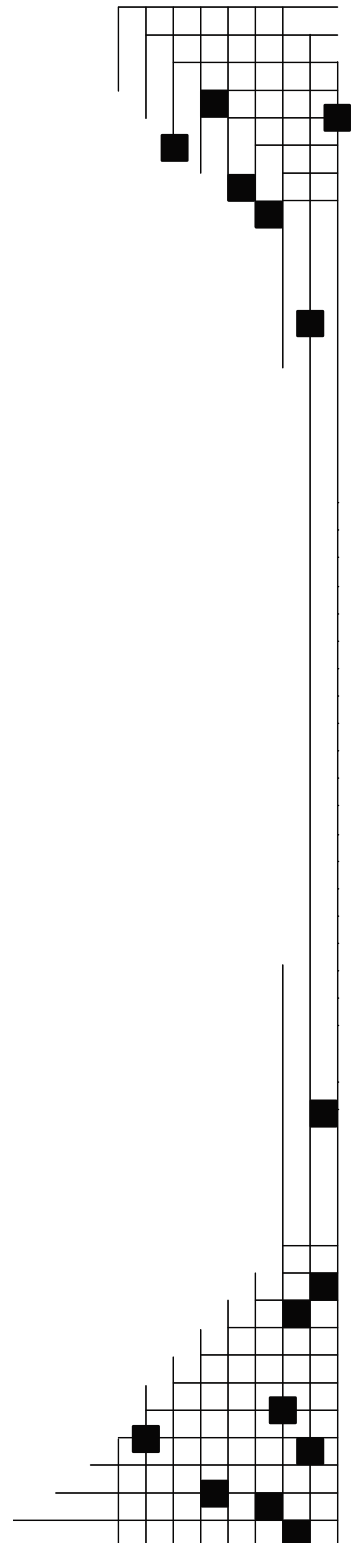
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RTD Biodiesel (B20) Transit Bus Evaluation Interim Review Summary

The National Renewable Energy Laboratory (NREL) has been working with the Regional Transportation District (RTD) of Denver, Blue Sun Biodiesel, and Power Service Products to evaluate the in-use performance of buses operating on B20 (20% biodiesel and 80% conventional diesel fuel). Nine mechanically identical 40-foot transit buses (five operated on B20, four on conventional diesel) are being compared over the same duty cycle, the “Skip” route in Boulder, Colorado. In addition, laboratory tests compared the buses for fuel economy and emissions. This report summarizes the interim results for the period August 2004 through February 2005.

With fuel, labor, and parts data from RTD, NREL is documenting and analyzing vehicle operation. The objective is to compare B20 and conventional diesel buses in terms of engine performance, component wear, fuel economy, vehicle maintenance, and emissions. The results will help RTD—and other potential biodiesel users—consider future use of biodiesel fuel blends. The results also will help engine manufacturers in exploring the effects of B20 on engine durability.

On-Road Evaluation Results

Data collection began in late July 2004. The following are results for the 7 months of on-road data analyzed:

- The five B20 buses accumulated approximately 150,000 miles on B20 with the same use as the four diesel comparison buses, approximately 4,500 miles per bus per month (Figure 1). The B20 buses consumed approximately 5,000 gallons of fuel per month.
- There was no significant difference between the average fuel economies of the two groups—4.59 mpg for the diesel buses, 4.53 mpg for the B20 buses (Figure 2).
- Average miles between road calls were 4,157 miles for the diesel buses, 4,686 miles for the B20 buses (Figure 3).
- Total maintenance costs for the two groups were \$0.51/mile for the diesel buses, \$0.47/mile for the B20 buses (Figure 4). Engine and fuel system maintenance costs were \$0.04/mile for the diesel buses, \$0.03/mile for the B20 buses. These differences in maintenance cost are not believed to be significant. Labor cost is assumed to be \$50/hour for all maintenance cost calculations.

Laboratory Test Results

- Bus emissions were measured on a chassis dynamometer over the City Suburban Heavy Vehicle Cycle (CSHVC), because the CSHVC is similar to the Skip route duty cycle. In these laboratory tests, buses fueled with B20 demonstrated lower fuel economy and emissions (Figure 5), results that are significant at the 99% confidence level:
 - Nitrogen oxides (NO_x) - 4%
 - Total hydrocarbons (THC) - 29%
 - Carbon monoxide (CO) - 24%
 - Particulate matter (PM) - 18%
 - Fuel economy - 3%

As of this date the buses have completed 12 months of operation on B20. Based on the positive results and high quality data obtained to date, the buses will be evaluated for a 2nd year of operation to provide additional B20 fuel and maintenance history and longer-term engine durability information. NREL will continue to provide data analysis and reporting of project results.

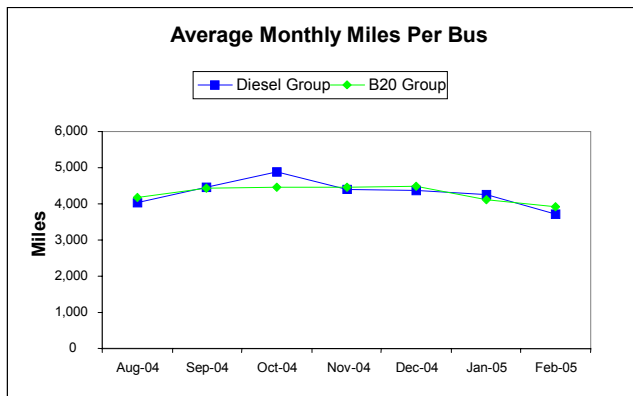


Figure 1

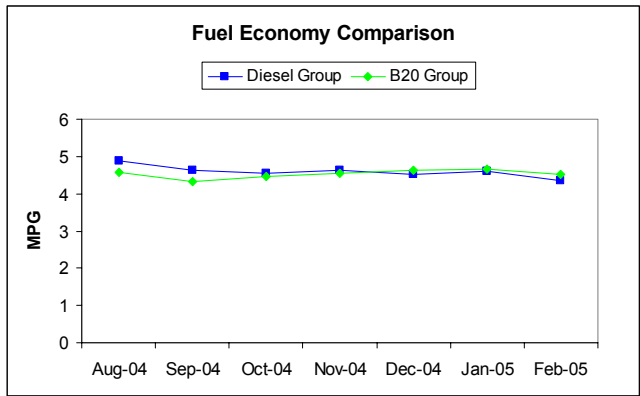


Figure 2

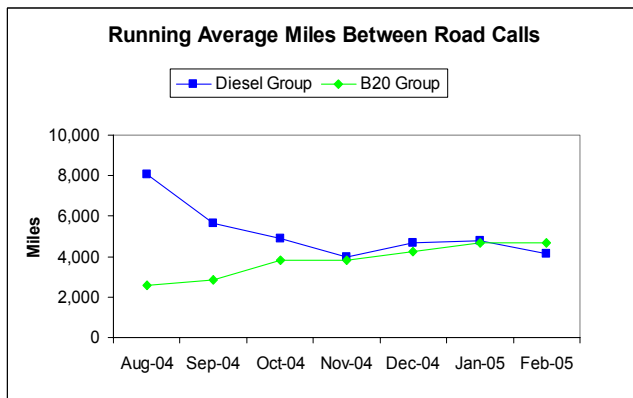


Figure 3

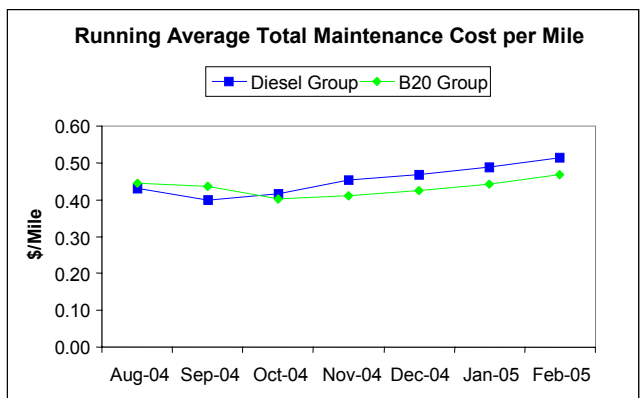


Figure 4

Laboratory Test Results

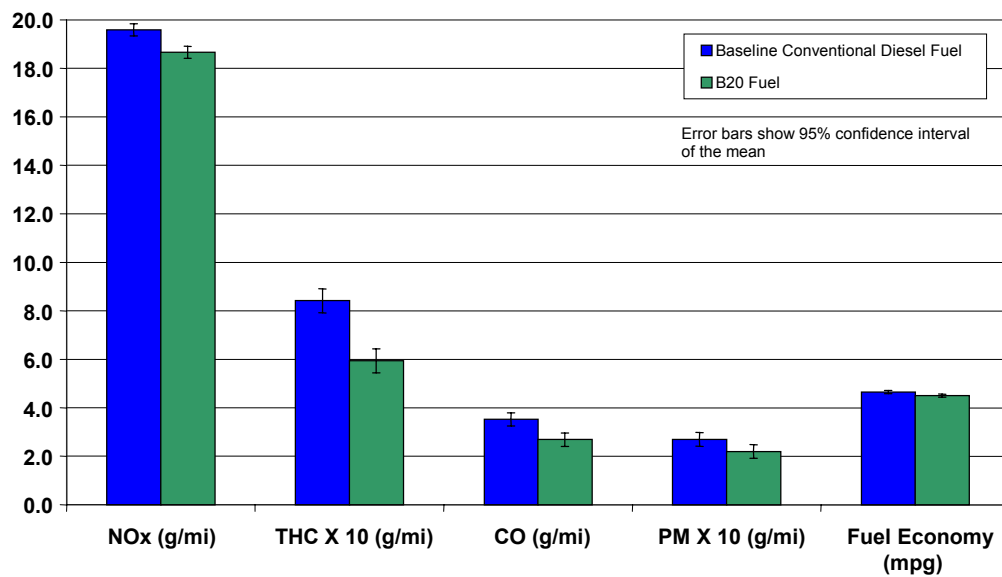


Figure 5

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